Name_____

Date_____ **Pd**____

E&M - Worksheet 7
Electric Potential Energy and Electric Potential

For each problem below, identify which situation (final or initial) where the system has more electrical potential energy. Explain your reasoning.

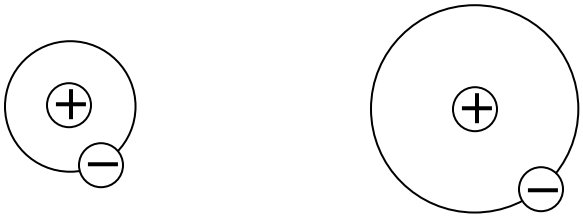
1. Initial Final Explanation

2. Initial Final Explanation

3. Initial Final Explanation

4. A hydrogen atom has a negatively charged electron that occupies the space around the positively charged proton at its nucleus. The figure below shows this. The electron makes a circular orbit around the proton.

Initial Final Explanation

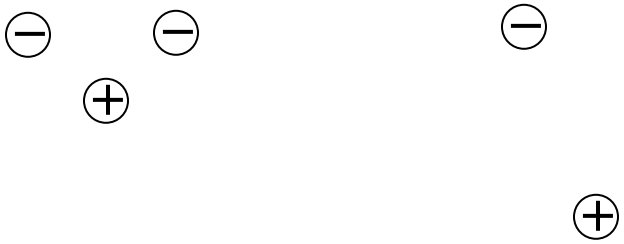


5. Given the three charges below, compare the energy of the initial and final states.

Initial Final Explanation

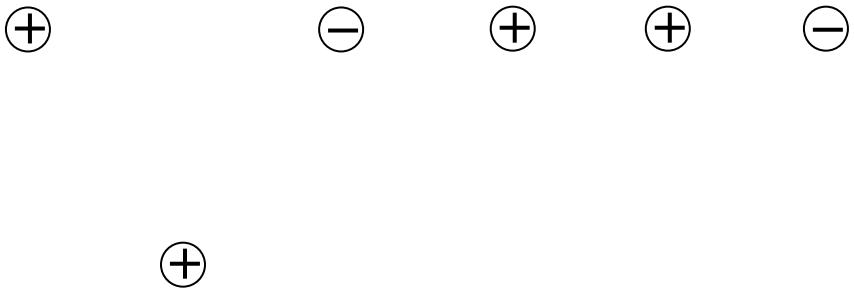
6. Given the three charges below, compare the energy of the initial and final states.

Initial Final Explanation

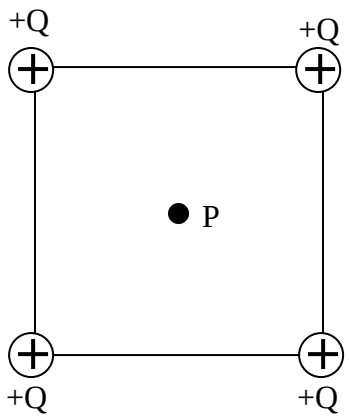


7. Given the three charges below, compare the energy of the initial and final states.

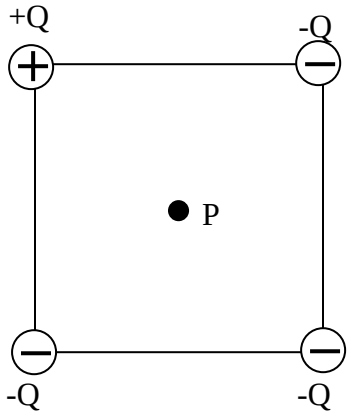
Initial Final Explanation



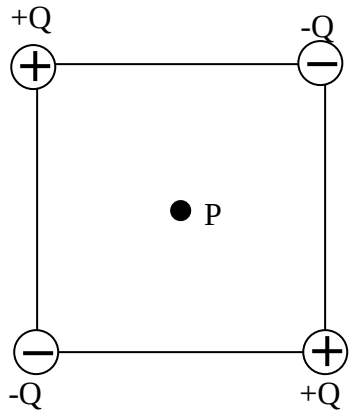
8. Point P is located at the center of the square below. Draw a vector with its tail on point P indicating the direction of the electric field at the point. If the value of the electric field at P due to one point charge is **E**, what is the value due to the 4 point charges? If the value of the electric potential at P due to one positive point charge is **V**, what is the value due to the 4 point charges?

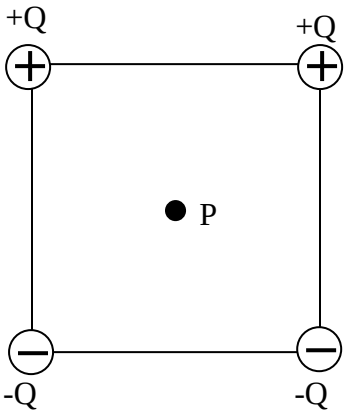


9. Point P is located at the center of the square below. Draw a vector with its tail on point P indicating the direction of the electric field at the point. If the value of the electric field at P due to one point charge is **E**, what is the value due to the 4 point charges? If the value of the electric potential at P due to one positive point charge is **V**, what is the value due to the 4 point charges?

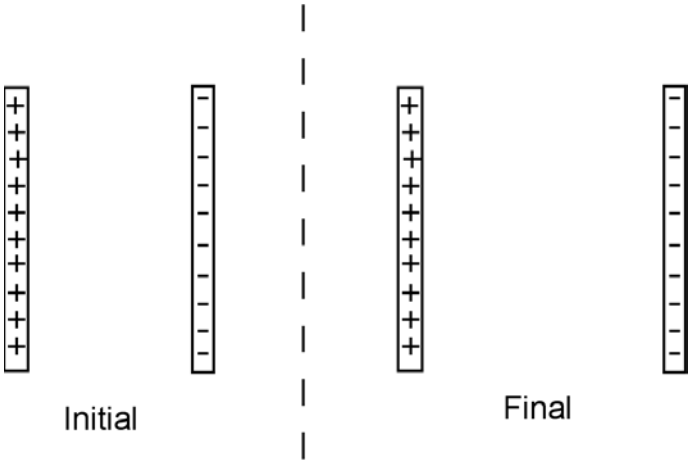


10. Same instructions for both systems below. Draw a vector with its tail on point P indicating the direction of the electric field at the point. If the value of the electric field at P due to one point charge is **E**, what is the value due to the 4 point charges? If the value of the electric potential at P due to one positive point charge is **V**, what is the value due to the 4 point charges?



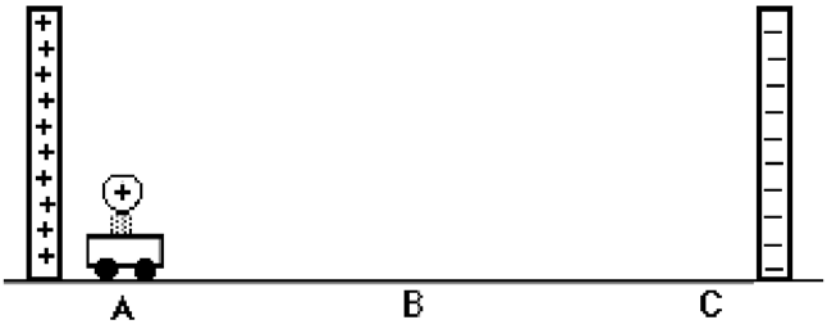


11. The two plates below have opposite charges. Compare the electric potential energy of initial and final states. Explain.



12. Compare the potential difference between the plates and the field strength of the initial and final states.

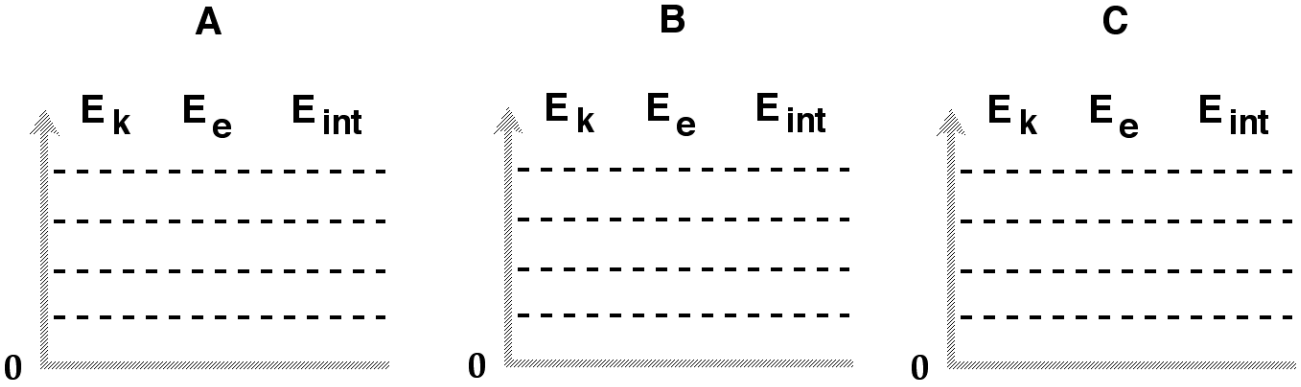
13. A cart on a track has a large, positive charge on the top and is located between two sheets of charge. Initially at rest at point A, the cart moves from A to C.



a. Draw qualitative force diagrams for the cart when it is at each position A, B and C.

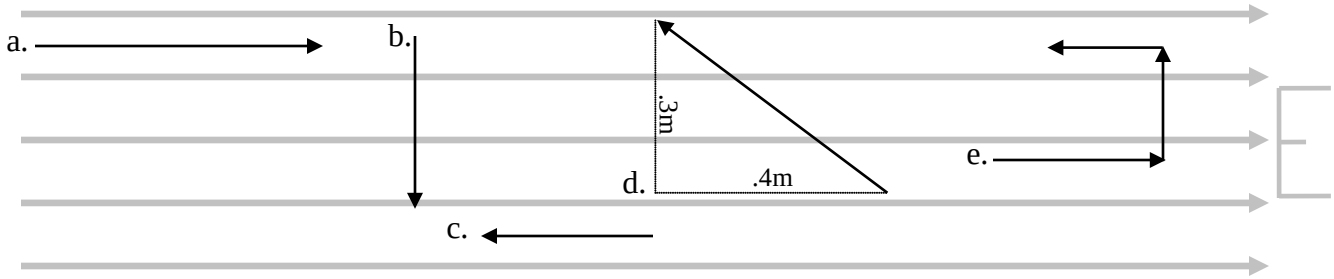
A B C

b. Draw qualitative energy bar charts for the system when the cart is at each position A, B and C. (Be sure to first identify the objects that make up your system.)



14. How would your force and energy diagrams change (if at all) if the sheet to the right were also positively charged?

15. Below is a constant electric field to the right with a magnitude of 650 V/m. Determine the change in potential for each of the paths.



a. 0.50 m to the right

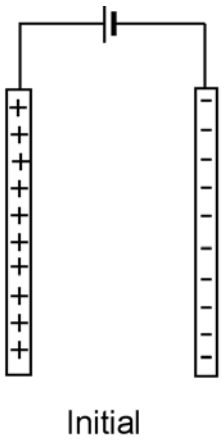
b. 0.30 m down

c. 0.30 m to the left

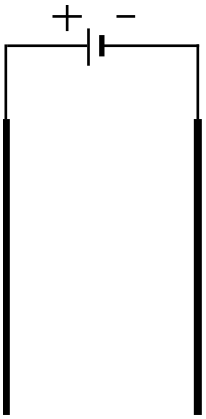
d. 0.50 m up and to the left

e. 0.3 m right, .2 m up and .2 m left

16. The plates at right are connected to the terminals of a 6 V battery. How does the amount of charge on the plates change (if at all) if the plates are pulled farther apart while remaining connected to the battery? Explain.



17. An electron is placed midway between two parallel conducting plates that are spaced 3.0 mm apart. The plates are attached to the terminals of a 12.0 V battery.



a. What is the direction and magnitude of the electric field?

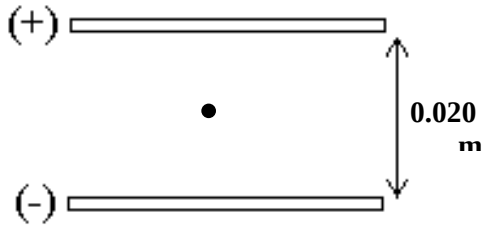
b. How much work would be done by moving the electron from the midpoint to the surface of the (-) plate? Express in both J and eV.

c. If the electron were released from a point midway between the plates, what would be its velocity when it struck the (+) plate?

d. If the potential difference were doubled, how much faster would the velocity be?

18. Robert Millikan determined the charge of an electron by suspending a charged drop of oil between two parallel plates like those shown at right. (This is a side view of the setup.)

a. What forces act on the suspended oil drop? Draw a force diagram that supports your answer.



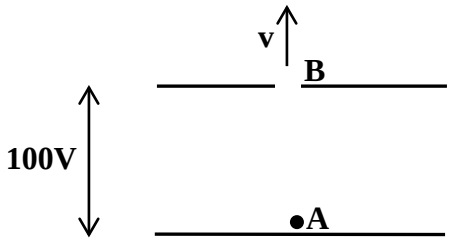
b. Assuming the mass of the oil drop is 4.0×10^{-15} kg, the potential difference between the plates is 1630 V, and the separation between the plates is 0.020 m, what is the charge on the oil drop?

c. How many excess electrons are on the oil drop?

19. A beam of protons is shot with an initial velocity of 5.00×10^6 m/s at a metal plate. This plate has a potential 4.00 kV higher than the proton beam source. What is the velocity of the protons just prior to striking the plate?

20. An unknown charged particle (an electron or proton) is placed at point A between two parallel plates. The particle is released from rest and accelerates toward the other plate. The particle emerges through the hole at point B with a speed of 1.4×10^5 m/s. The potential difference between the two plates is 100V.

a. Is the unknown particle an electron or proton? Justify your answer.



b. Which plate (top or bottom) is positively charged?

21. If we decide to call the electric potential at an infinite distance away 0 volts, what is the electric potential .40 m from a point charge of +8.0 μC?

b. If a +2.2 nC charged plastic sphere is moved in from an infinite distance away to a point .40 m from the +8.0 μC point charge, what is the change in energy of the system? (in real life, moving it in from 10 meters away would give essentially the same value)

c. If the 1.0 gram charged plastic sphere is released from rest, how fast will it be traveling after it moves 0.50 m in straight line radially away from the point charge?